OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
CANADIAN INTELLECTUAL PROPERTY OFFICE

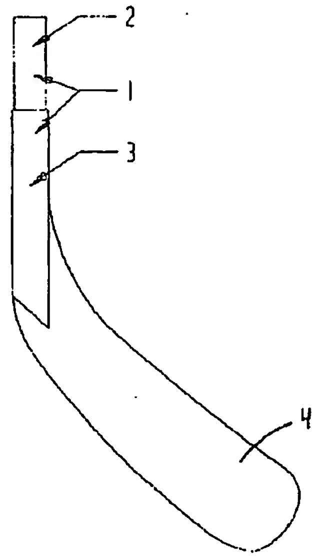
(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,223,098**
(22) 1998/01/28
(43) 1998/03/18
(45) 1998/12/01

(72) SUTHERLAND, Terrance W., CA
(73) CE Composites Hockey Inc., CA

(51) Int.Cl.^{6} A63B 59/14, B29C 70/34, B29D 31/00
(30) 1997/08/11 (08/909,252) US

(54) **VIROLE EN MATERIAU COMPOSITE RENFORCEE ET METHODE DE FABRICATION DE CETTE VIROLE**
(54) **COMPOSITE REINFORCED HOSEL AND METHOD**



(57) Virole en bois renforcée de fibres pouvant être intégrée à une palette de bâton de hockey en bois ou en matériau composite, servant à relier la lame au manche creux d'un bâton de hockey. Cette virole est renforcée de fibres liées sur la pleine longueur des côtés porteurs principaux, parallèles aux faces de la lame.

(57) The invention consists of a fiber reinforced wooden hosel which can be incorporated into both wooden and composite hockey stick blades to act as the point of attachment of the blade to the hollow hockey stick shaft. This hosel has fiber reinforcement bonded to the entire length of its primary load bearing sides, parallel to the faces of the blade.

ABSTRACT

The invention consists of a fiber reinforced wooden hosel which can be incorporated into both wooden and composite hockey stick blades to act as the point of attachment of the blade to the hollow hockey stick shaft. This hosel has fiber reinforcement bonded to the entire length of its primary load bearing sides, parallel to the faces of the blade.

COMPOSITE REINFORCED HOSEL & METHOD

The present invention relates generally to hockey stick blades and, more specifically, to the hosel, and its manufacturing, which is incorporated into hockey blades and which is designed to be inserted into a hollow hockey stick shaft, thus connecting the blade to the shaft.

BACKGROUND OF THE INVENTION

The Webster's dictionary definition of the term hosel refers to a socket in the head of a golf club into which the shaft is inserted. In the games of ice and road hockey, the term hosel, sometime spelled hozzle or hozel, is applied to the, usually wooden, vertical extension of the hockey stick blade, one end of which, the lower, is to be attached to the blade and the other, the upper, end of which is inserted into a hollow hockey stick shaft of aluminum or composite or other material construction.

Figures 1 to 4 reveal the prior art.

Figure 1 illustrates a one piece hosel **1**, which is formed into a section **3** tapered in cross-section to smoothly join to a blade **4**, and a tenon **2**, of cross sectional dimensions chosen to allow it to be attached to the interior surfaces of the hollow hockey stick shaft into which it is inserted either by use of a thin layer of hot-melt adhesive or of some mechanically adjustable or deformable fastener element.

Figure 2(a) illustrates the morphology of a typical hosel in more detail. The dimensions vary from manufacturer to manufacturer but the basic functional elements are illustrated. The tenon **2** is usually of constant rectangular cross section if it is to be bonded to the hollow shaft by the use of adhesives. If other mechanical or deformable elements are used to effect the attachment, the tenon **2** can be of varying cross sectional area along its length and can incorporate machined holes or slots into which these elements are inserted. The lower section **3** of the hosel **1**, which extends beneath

the shaft to attach to the blade, is usually beveled on both lateral faces parallel to the blade at a constant angle determined by the upper dimension being equal to the exterior width of the hockey shaft, and a narrower dimension, chosen to allow a smooth integration of the lower end of the hosel into the blade.

As illustrated in Figure 2(b), in some cases the lower end of the hosel is adapted to be inserted into a slot or receptacle in the blade. In other cases, it is simply butted up against a blade core and attached by adhesive or mechanical fasteners and then a series of fiber-resin composite layers are placed over this hosel and blade assembly and cured by applied heat and pressure. The dimension **5** and angle **6** of the hosel are selected to smoothly integrate with the outer surface of the shaft and the heel area of the blade or blade core respectively. The hosel length is typically in the 20-30 cm range.

Traditionally, these hosels have been machined from constant, rectangular cross section laminates **13** of select woods, as shown in Figure 3(a). Ash and birch are often used in their construction. A more recent development, also shown in Figure 3(a), has been the use of fiberglass sheets **15** or rovings wetted bonded into rectangular cross section wood layers as additional lamination layers, with at least one additional layer of wood **16** bonded to the fiberglass sheets as the outer layer on each lateral face of the hosel blank. The fiberglass layers are pre-manufactured in sheets, by processes such as hand lay-up, roll forming or pultrusion, and are cut to the required size for use in the hosel blank laminate. The resin, usually polyester, vinylester or epoxy, in which the glass fibers are embedded, is fully cured before the fiberglass layers are incorporated into the hosel blank laminate. These fiberglass sheets sandwiching the wooden core **14** provide increased strength and stiffness to the hosel blank. As an alternative to the sheets, fiberglass rovings wet with resin are cured between the layers of wood.

Figure 3(b) illustrates the hatched cross section of a hosel **17**, from the same end viewpoint as Figure 2(a), superimposed on the hosel blank **13** from which it is machined. In this case, the blank is one which contains two fiberglass layers **15** in the laminate, sandwiching the core **14** but with at

least one additional layer of wood **16** bonded to the fiberglass sheets as the outer layers on each face of the hosel blank, as is typical of all commercially available glass reinforced hosel blanks. It is important to note that the hosel, at points **18**, is of a thinner section than the sum of the thicknesses of the core **14** and the two fiberglass laminate layers **15**. Thus the typical hosel cut from commercially available glass reinforced laminates has no glass reinforcement layers sandwiching its core from point **18** downwards. Based on measurements of commercially available products, the lower 20-25% of the hosels is not glass reinforced.

The prior art as expressed in patents, patent applications and commercial literature reveals no reference to the importance of the strength and stiffness of the hosel of a hockey stick blade to the performance and durability of that hockey stick blade. The relevant patent literature merely concerns various hockey stick shafts with fiber reinforcements applied to the opposing faces of the shaft by various methods.

In a large proportion, the incidence of breakage or delamination failures in hockey sticks occurs at the junction of the blade and the shaft, that is in the area of the hosel. It is well established that tremendous force is required to propel a hockey puck at the speeds in excess of 160 kilometers per hour typical of slap shots by advanced players. These forces are first applied to the shaft by the players arms and hands and are then transferred down through the hosel into the blade. The stresses applied in the shot also create a torque reaction in the shaft, in the hosel area and hence in the blade. Uncontrolled torque can result in an uncontrolled shot. Thus control of the stiffness of all three components of a hockey stick - shaft, hosel and blade - is critical to ensuring the production of a high performance stick.

SUMMARY OF THE INVENTION

The present invention overcomes the above shortcomings.

The present invention increases both the strength and stiffness of the hosels used in the

manufacture of hockey stick blades and is lighter. This will, as a result, lower the rate of failures that occur in the hosel area, and will also increase the torsional and longitudinal stiffness of the hosel, hence increasing the accuracy and speed of shots made with blades and sticks incorporating the invention.

The invention stems from the recognition that there are two limitations of commercially available fiber reinforced hosels that result in their being weaker and less strong than optimum.

Firstly, it has been shown that in glass reinforced hosels, the lower 20-25% of the hosel is typically not glass reinforced once it has been machined from the hosel blank. This creates a relatively weak area, and a stress concentration gradient, in the general area in which a large proportion of hockey stick failures are found to occur. Player's experience has revealed that the majority of these breakages occur below the point where the glass reinforcement has been machined away.

Secondly, it is well established that the strength and stiffness of a sandwich structure, such as a glass reinforced hosel blank which has a core of wood sandwiched between two layers of fiberglass, increases as a function of the increasing separation between the reinforcing faces applied to the sandwich core. The further the reinforcing skins are separated from the neutral axis of the sandwich structure, the stronger and stiffer the sandwich becomes. The flexural strength of the sandwich panels is governed by complex equations that depend on the relative properties and dimensions of the core and the reinforcing faces. However, for a given set of materials, the stiffness of the sandwich increases as approximately the cube of the increase in spacing between the reinforcing skins on the core. The strength increase with increased separation of the reinforcing skins is less but is still significant. For example, if it were possible to increase the spacing **10,** as shown in Figure 4, of the fiberglass reinforcement sheets sandwiching the wood core by 20%, the stiffness of this hosel would be increased by 73% and the strength would be increased by 44%. All reinforced hosels and hosel blanks currently being marketed utilize an outer layer of wood laminate on top of each glass laminate for ease of joining these hosels to wooden blades with standard adhesives.

As a consequence of moving the fiber reinforcement to the outside of the hosel, on the order of 20% further away from the neutral axis of the hosel than in conventional reinforced hosels, this hosel is over 60% stronger and stiffer than conventional fiber reinforced wooden hosels used for the same purpose. The result, when used in a blade, is a stronger and stiffer hockey stick blade, with improved playing characteristics, such as puck speed and shooting accuracy, and with a greater resistance to breakage than a blade made with a conventional hosel. Another significant benefit of this invention compared to machined wood surface hosels is control of dimensional variations that can adversely effect the ability to insert and bond or otherwise attach the tenon of the hosel into a hollow composite or aluminum shaft. . The tight tolerances of the closed mold process used to place fiber reinforced resin layers on the faces of the hosel result in tighter control of dimensional tolerances than for conventional wood surfaced adhesively reinforced hosels.

Thus another object of the invention is to ensuring repeatable dimensional tolerances and excellent control of the fit of the tenon end of the hosel into the hollow shaft.

The present invention is for use primarily in composite and ABS blades, although it can be used in wooden blades, and is characterized by the elimination of these outer wooden layers and the effective use of a thicker wooden core, resulting in a wider spacing of the fiber reinforcing layers and, as a result, a stronger and stiffer hosel.

In accordance with yet another object of the present invention there is provided a method of manufacturing a hosel comprising the following steps: a) applying a fiber and resin mixture to the lateral faces of the pre-shaped core of a hosel; b) clamping said hosel between a pair of conforming heated metal dies; c) subjecting said hosel to pressure and temperature for a specific length of time; and d) trimming said hosel off; whereby integral curing and bonding of the resin fiber mix to the faces of the hosel is achieved and controlled to minimize variations in the dimension of the molded hosel.

In accordance with still another object of the present invention there is provided a hosel for use in constructing a blade of a hockey stick having fiber reinforced resin sheets molded in situ to the outside surfaces of at least two opposing lateral faces of the pre-shaped core of the hosel.

Further objects and advantages of the present invention will be apparent from the following description, reference being made to the accompanying drawings wherein preferred embodiments of the invention are clearly shown.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further understood from the following description with reference to the drawings in which:

Figure 1 is a side view of a hockey stick blade assembly for insertion into a hollow shaft showing the location of the hosel in the blade assembly;

Figures 2(a) and 2(b) are side views of typical wooden hosels;

Figure 3(a) is a cross-sectional view of a standard fiberglass strip reinforced blank from which conventional reinforced hosels are manufactured;

Figure 3(b) is a cross-sectional view showing, in crosshatched section the outline of the hosel which is machined from the wooden blank;

Figure 4 is a side view of a conventional reinforced hosel;

Figure 5 is a side view of one preferred embodiment of the invention;

Figure 6 is a side view of a second preferred embodiment of the invention;

Figure 7 is a side view representative of both of these preferred embodiments of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In a first preferred embodiment of the present invention, as shown in Fig. 5, a hosel **19** is

machined to the final required finished shape, with one dimensional exception, from a piece of wood or wooden laminate that is not reinforced by fiberglass. The dimensions of the hosel are standards, as shown in Figures 2(a)-2(b) with the exception that the transverse thickness of the hosel in Fig. 5 is reduced by an amount equal to the thickness **22** of two layers of fiber reinforced resin which are to be applied to the opposite lateral faces of the hosel such that the thickness of the hosel , at all points along its length, when the fiberglass layer is applied and bonded, will be identical to the thickness of the hosel in Figure 2(a) at those same points. In this preferred embodiment the transverse thickness is reduced by 0.180 mm from the design thickness required for the finished, reinforced hosel.

In this preferred embodiment, the layer of fiber reinforced resin consists of 65% by volume unidirectional e-glass of 225 yield mixed with 35% by volume epoxy resin. The layers of glass and epoxy are chosen to result in a reinforcement skin that is 0.09 mm thick on each side when cured. The fibers are oriented parallel to the longitudinal axis of the hosel. The resin and glass mixture are placed into a pair of conforming heated metal dies which are applied to the opposing lateral faces of the hosel **19** as shown in Figure 5 and are clamped between a pair of conforming heated metal dies and are then subjected to pressure between 350 and 800 psi, preferably 600 psi, and a temperature of 150°C for 5 minutes.

The fiber reinforced resin can consist of any combination of glass, carbon, aramid or other structural reinforcement fiber with epoxy, polyester, vinylester or and other thermoset or thermoplastic resin suitable for use with the individual fibers based on common industrial experience. The epoxy can also be rubber modified to toughen it. It should also be noted that the fiber components can be oriented at angles varying from 0 to 90° to the longitudinal axis of the hosel. Also, the fiber components can be bonded directly to the hosel using a wet resin process.

The hosel with the cured laminates applied and bonded to its opposing lateral sides is removed from the matched dies and any excess resin or fiber flashing is trimmed off. The hosel is then ready for use in the manufacture of a composite or wooden hockey stick blade.

Mechanical testing of the hosel of the preferred embodiment was conducted, by gripping the tenon in a clamp applied to the fiberglass reinforced faces and applying force with a hydraulic test rig to the lower tip of the hosel. This testing proved that the hosel of this preferred embodiment of the invention was lighter, stronger and stiffer than commercially available hosels of the type described in the prior art.

Another significant benefit of this invention compared to machined wood surface hosels is control of dimensional variations that can adversely effect the ability to insert and bond or otherwise attach the tenon of the hosel into a hollow composite or aluminum shaft. . The tight tolerances of the closed mold process used to place fiber reinforced resin layers on the faces of the hosel result in tighter control of dimensional tolerances than for conventional wood surfaced adhesively reinforced hosels. Another preferred embodiment of the invention has fiber reinforced-resin sheets applied to all four sides of the hosel, ensuring repeatable dimensional tolerances and excellent control of the fit of the tenon end of the hosel into the hollow shaft.

In a second main embodiment of the invention, the hosel **24**, as viewed in Figure 6, is machined as per the first preferred embodiment however the thickness of the hosel on two faces at point **25** is machined to fit the inside width of the hollow shaft into which the tenon is to be inserted. Thus there is no thickness discontinuity or step at point **25** between the tenon and the lower part of the hosel on two faces.

However, in both of these embodiments of the invention there is a dimensional discontinuity or step at point **26** as shown in Figure 7, when the hosel is viewed from the side, with the result that at least two opposing faces of the tenon will have a step which will limit the depth to which the tenon can be inserted into the hollow shaft to a maximum length.

In this second preferred embodiment, once again, the fiber and resin mixture is applied to the opposing lateral faces of the hosel **24** as shown in Figure 6 and are clamped between a pair of conforming heated metal dies and are subjected to pressure and temperature for a length of time

suitable to cure the resin and bond the resin fiber mix integrally to the surfaces of the wooden hosel.

In a third embodiment of the invention, a glass or other fiber cloth with fibers at angles other than parallel to the longitudinal axis of the hosel is mixed with resin and bonded to the hosel as described in the previous embodiments. By varying the amount of reinforcing fiber at off axis angles and the angles at which the fibers lie, the amount of torsional stiffness of the resultant reinforced hosel, and hence the amount of torsional flexure of the shaft to blade joint, can be designed and tailored to suit different players requirements for both puck control and puck feel during a shot.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes that come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of manufacturing a hosel comprising the following steps:
   a) applying a fiber and resin mixture to the lateral faces of the pre-shaped core of a hosel;
   b) clamping said hosel between a pair of conforming heated metal dies;
   c) subjecting said hosel to pressure and temperature for a specific length of time; and
   d) trimming said hosel off;
   whereby integral curing and bonding of the resin fiber mix to the faces of the hosel is achieved and controlled to minimize variations in the dimension of the molded hosel.

2. A hosel for use in constructing a blade of a hockey stick having fiber reinforced resin sheets molded in situ to the outside surfaces of at least two opposing lateral faces of the pre-shaped core of the hosel.

3. The hosel of claim 1 or 2 wherein the pre-shaped core is wood.

4. The hosel of claim 1 or 2 wherein the pre-shaped core is laminated wood.

5. The hosel of claim 1 or 2 wherein the fibers are continuous and are oriented substantially parallel to the length of the hosel.

6. The hosel of claim 1 or 2 wherein the fibers are bonded directly to the hosel with a wet resin process.

7. The hosel of claim 1 or 2 wherein the fibers are any combination of glass, graphite, aramid, boron, alumina or thermoplastic fibers wherein the percentage of each fiber species used can vary from 0 % to 100%.

8. The hosel of claim 7 wherein any percentage of any of the fiber components can be oriented at any angle from 0 to 90 degrees to the longitudinal axis of the hosel.

9. The hosel of claim 1 or 2 wherein the resin contains epoxy.

10. The hosel of claim 9 wherein the epoxy is rubber modified.

11. The hosel of claim 1 or 2 wherein the resin contains polyester.

12. The hosel of claim 1 or 2 wherein the resin contains vinylester.

13. The hosel of claim 1 or 2 wherein the resin used is a thermoplastic

14. The hosel of claim 1 or 2 wherein at least two of the faces of the hosel parallel to its longitudinal axis have a step machined into them at the base of the tenon.

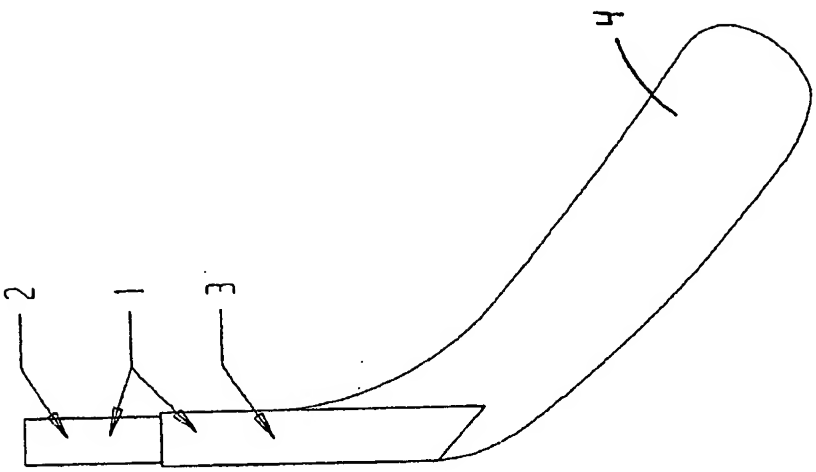


fig. 1

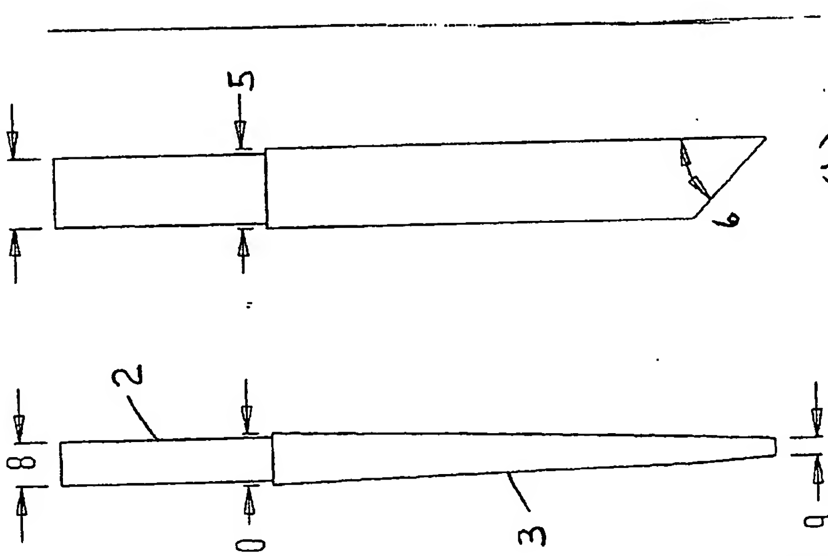


fig. 2

CA 02223098 1998-01-28

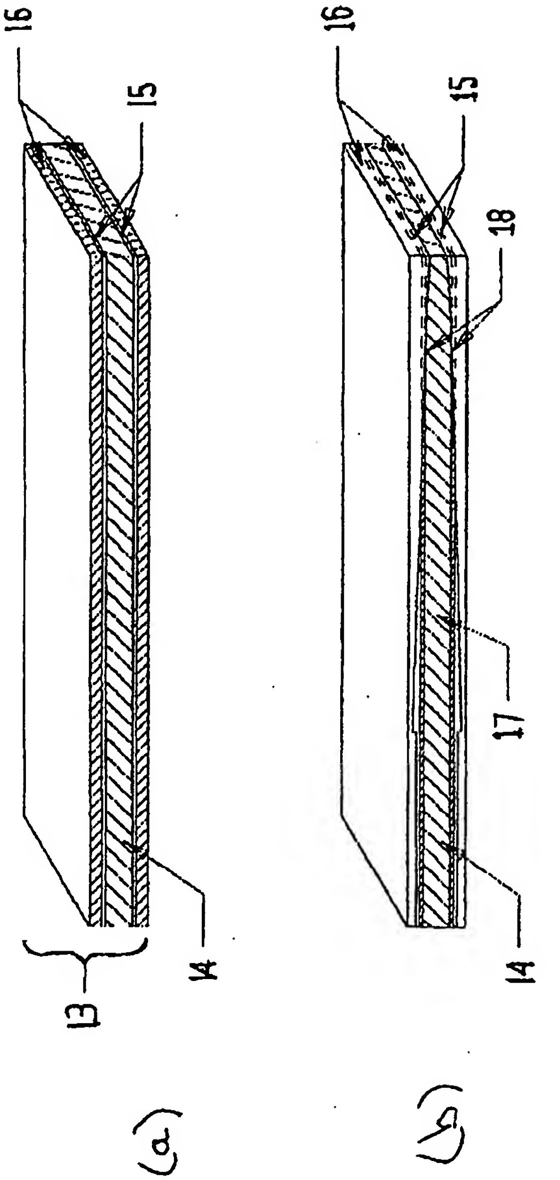


fig. 3

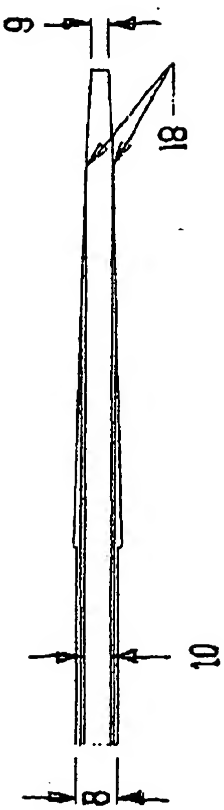


fig. 4

CA 02223098 1998-01-28

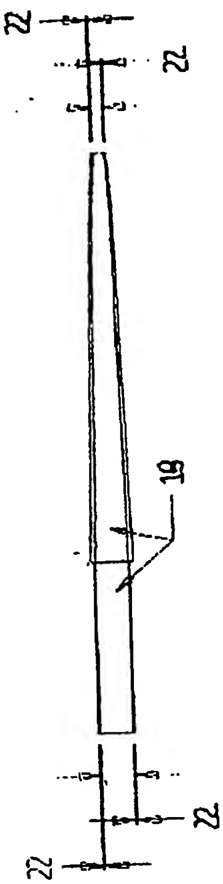


fig. 5

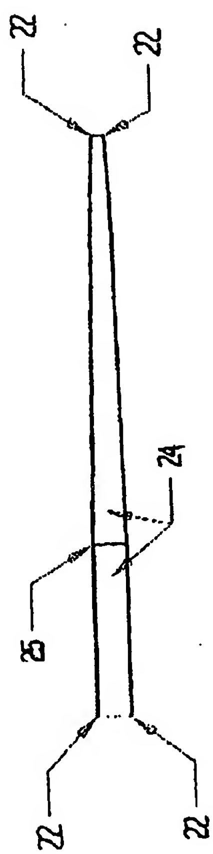


fig. 6

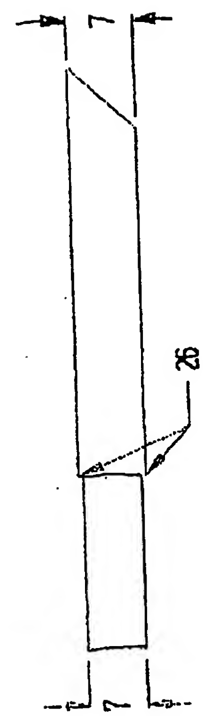
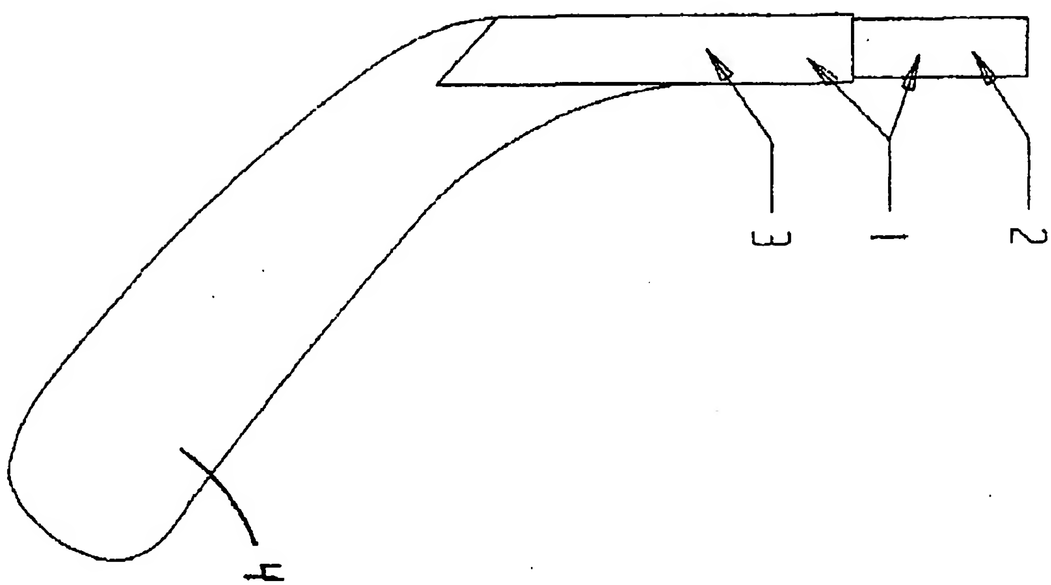


fig. 7


3
1
2
4